their repeated warnings, but little attention has hitherto been given. We mean the composition of the charcoal. According to the manner of preparing this, the method adopted for charring and the material employed, so does the chemical composition of the charcoal differ. Some samples, for instance, prove on analysis to contain 85 per cent. of carbon, while others have 20 per cent. less; it is scarcely to be expected that gunpowder made from the two kinds will have the same burning qualities, and yet with gunpowder manufactures charcoal is charcoal, no matter how much its component parts of carbon, hydrogen, oxygen, and ash may differ. It is of little use, therefore, paying any particular attention to the physical qualities of gunpowder so long as its chemical composition is almost entirely ignored.

The manner in which the strain upon the gun and the velocity of the shot are measured at Woolwich are worthy of explanation. The means employed are of the simplest kind. The maximum pressure of the gases inside the gun as the shot is being expelled is recorded by what is termed a "crusher gauge." This is no more than a tiny pillar of copper. The pillar is placed loosely in a tube, the end of which, made of steel, stands firm and fast no matter what the pressure. So that the soft copper pillar, when subjected to the action of the gas, gets compressed, or crushed, and assumes something of a barrel shape. The pillar and its case, being affixed to the base of the shot, gets the full pressure of the gunpowder gases, and its length afterwards denotes how much this pressure has been. To secure more trustworthy pillars of the metal it is the practice to compress them first of all to a certain degree, to remove any honeycomb or imperfection, and, thus uniformly compressed, they may be relied upon to record the strain with accuracy. Comparison of the fired pillar, with other pillars which have been subjected to known pressures, at once reveals the degree of force to which the former has been subjected in the gun. The maximum pressure, or strain, to which the 80-ton gun should be subjected, is set down as 25 tons on the square inch, and it is with the aid of this "crusher-gauge" that the strain exerted in the various experiments has been ascertained.

The initial velocity of a shot, or, in other words, the rapidity with which a projectile flies at the outset of its career, is now measured by an electrical instrument, the invention of Major le Boulengé, a Belgian officer. As in the case of other instruments of a like nature, the shot is made to break through two wire screens, placed at some distance from one another. The interval is usually about 100 feet. The screen is simply a wooden framework with fine wires zigzagging across, and it is these fine wires which the shot cuts. One screen is near the muzzle of the gun, and the other at the distance we have mentioned. No. 1 screen is in connection with an electro-magnet in the instrument-house, and No. 2 screen with a second, the two magnets hanging close together. While the wires in front of the screen are perfect, an electric current passes without interruption, and the electro-magnets in connection with them are endowed with power, but this power ceases as soon as the shot cuts the wires of the screen. Before the gun is fired there is suspended to the magnets two rods of iron, which remain, however, only so long as the magnets are magnets. When the shot is fired, No. 1 screen is torn, and down falls the rod suspended to No. 1 magnet; an instant afterwards, when the shot has reached No. 2 screen, No. 2 magnet also loses it virtue, and down falls the second rod. The time between the falling of the two rods is so small, that ere the first has fallen half its length the second has dropped upon a trigger, which trigger darts out and strikes the side of No. 1 rod. When the latter is picked up, the first thing is to examine the surface for the mark of the trigger, for the position of this mark, whether high or low, tells the operator what he wants to know. The rod being of a given weight, always takes the same time to fall, and according whether it has fallen half or quarter its length, so the time taken by the shot to travel between the screens has been long or short. In a word, the rod has only to be compared with a prepared scale in order to read off the number of feet per second at which the shot has gone on its way.

THE REGISTRARSHIP OF LONDON UNIVERSITY

LAST week we referred to Dr. Carpenter's intended resignation of the Registrarship of the University of London. We have before us his letter intimating his desire to resign his post on May 31 next, and the resolution of the Senate in connection therewith. By the date mentioned Dr. Carpenter will have completed his twenty-third year as Registrar, and, including his previous nine years as Examiner, his connection with the University has extended over four-fifths of its term of existence, and over a corresponding proportion of his own professional life. There is no doubt that the success of this great institution is to a great extent owing to the energy and faithfulness with which Dr. Carpenter has discharged the duties of his post. It has been fortunate for the University as well as for science that a man of so eminent a scientific position has been so long and so intimately connected with it, and it will be extremely difficult to find one capable of taking up adequately Dr. Carpenter's work. We have pleasure in publishing the resolution of the Senate, to which we have referred.

"In accepting the Registrar's resignation of the important office he has held since 1856, the Senate desire to record their sense not only of the ability, judgment, and fidelity with which he has uniformly discharged its duties, but also of the zeal and efficiency with which he has on all occasions exerted himself both within and beyond the limits of his official obligation, for the promotion of the best interests of the University.

"The Senate would further record their conviction that it has been of special advantage to the University, during the twenty years of its most rapid development, to have had the services of a Registrar who, besides being an excellent administrator of its affairs, has attained, by his scientific labours, a position which has given him a just weight and influence over those with whom he has been brought officially into contact.

"The Senate strongly recommend the Registrar to the favourable consideration of the Lords of Her Majesty's Treasury as having acquired, by 'special services,' a claim to a larger superannuation allowance than that to which he is entitled by mere length of service."

ABOUT FISHES' HEADS

IN a former number (vol. xvii., p. 286), in a note "About Fishes' Tails," we called attention to some recent observations of Alexander Agassiz on the young stages of some fishes, in which he showed the wonderful changes that, as development went on, took place in their caudal fins; yet strange though these changes are, they seem as nothing to those that take place in some fishes' heads, and the facts first noticed by Steenstrup, and the theory which, by a marvellous power of intuition, he built up thereon, as to the eye in a flounder passing from the right side of its head to its left, have been in a great measure confirmed, and perhaps in a greater measure added to, by the painstaking observations quite recently published, of Alexander Agassiz,[1] from which it would now seem very certain that even the most shapeless adult fishes begin their life as quite symmetrical young creatures. No more

[1] *Proceedings* of the American Academy of Arts and Sciences, vol. xiv., July, 1878.

unsymmetrical fish can probably be found than an adult flounder with its unsymmetrical tail, with its twisted head, with its two goggly eyes—brought together on the one side of that head—and yet examine a flounder while yet young. "The one I captured," writes Agassiz, "was so transparent as to rival the most watery of jelly fishes. When placed on a flat glass dish it could only be distinguished by allowing the light to strike it in certain directions, otherwise all that was visible were the two apparently disembodied bright emerald eyes moving more or less actively. It was over an inch in length, the position of the eyes was perfectly symmetrical, and they were placed at a considerable distance from the anterior extremity of the snout; the dorsal fin extended almost to the nostrils." From this beautiful symmetry how then did the strange want of it in the adult fish arise? Long ago (1863) this question presented itself to Steenstrup. He had a small number of very young flounders preserved in alcohol, and from an examination of these he answered the query thus:—The young flounder, after a short time, takes to lying on its right side, why no one can tell, but with this result that the eye of that side begins to turn inwards, and passing through the tissues of the head, transfers itself to the left side. So strange seemed this explanation, that Malm's observations, in which he seemed to show that this apparent transference was really due to a torsion or twisting of the entire head, appeared to some to be, perhaps, the most probable explanation of the extraordinary phenomenon described by Steenstrup, and yet in Steenstrup's paper he very clearly showed that any ordinary torsion of the head of a flounder on its axis was wholly insufficient to explain the final position of its eyes. Since 1863 a good deal has been written upon the subject of the want of symmetry in the heads of the so-called flat fishes, more especially by Sir Wyville Thomson, Dr. Ramsay Traquair, Dr. Schiodte, Dr. Klein, Professors Reichert and Canestrini; but the most important and the latest memoir is the one just published by A. Agassiz, which forms a second part of his memoir, "On the Young Stages of Osseous Fishes," and is devoted chiefly to the development of the flounders. This memoir is accompanied by eight excellent plates, some of which show very well the changes of form through which some of the young flounders pass. The young flounders of some species attain a considerable size ere they show the least tendency to favour one side more than another, and before there is any change in the position of the eyes. They then swim vertically, at least when they come up to the surface to feed. This they will do on bright sunny days, about ten o'clock in the morning, while the water is very smooth, and they will then be seen to devour greedily swarms of embryo crustaceans of all orders. Some will after a while settle down on their left sides, which then in time become colourless and blind, these would be called dextral, while in some just the reverse takes place; but no matter on which side they take to resting on, the exchange is the same. First there is a slight advance of the eye of the blind side towards the snout, then this rises higher and higher towards the medial line of the head; it now becomes more and more visible from the coloured side, until at last it quite passes over. This transfer commences, in eight species observed by Agassiz, very early in life, while all the face-bones of the skull are quite cartilaginous, and, by a combined process of rotation and translation, it is completed long before these have become ossified. So far these observations of A. Agassiz were completely in conformity with the observations of Malm, who, it will be remembered, did not trace the changes undergone during the process; and they seemed to be completely antagonistic to the idea of Steenstrup, that the eye from the blind side passed through the tissues of the head and came out on the coloured side. But in the late summer of 1875 a little shoal of some fifteen quite transparent flounders were captured by Agassiz, on a quiet and brilliant morning, on the surface of the water at the mouth of the harbour of Newport. They were swimming vertically, and violently rushing after the minute entomostraca which swarmed on the surface. They were at once transferred to shallow glass jars, in which they would remain at the bottom on their right sides, for hours immovable. When disturbed they were rapid in their movements, frequently jumping out of the water. When swimming vertically they usually moved obliquely, the tail being carried lower than the head. When one of these was looked at in profile, its right eye could be seen through the head, slightly in advance and a little above the left eye; owing to the great transparency of the body, the right eye was then nearly as useful as if placed on the left side. Gradually it rose, until in about six days it was well above the left eye; shortly after, wonderful to relate, it was seen to sink into the tissues at the base of the dorsal fin between this and the frontal; slowly it sank until the huge orbit became reduced to a mere circular opening. Little by little this became smaller and smaller, the eye pushed its way deeper into the tissues, until an additional opening was formed on the left side. At this stage there were three orbital openings, though of course but two eyes. The original or right-orbital opening soon became closed and the coloured side had its two eyes. Thus was the suggestion of Steenstrup proved to be correct by careful observation on a living form, and what is of even greater interest, A. Agassiz is, from having thus, as it were, seen all round the subject, enabled to suggest that the difference between these two methods of the transference of these eyes is not so great as would at first appear, the eye that sinks through the tissues, only taking a slightly shorter cut to arrive at its destination than the one that travels round the frontal bone. He is also able to hint at facts and suggest thoughts thereon, that seem to us to be as full of interest as of novelty. Only a few of these can we allude to, such as the great length of the optic nerve, which allows slack to be taken during the transfer of the eye, and yet does not cause the sight to be interfered with, and the direct and very active circulation taking place to and from the heart and the orbital cavity, constituting almost an ocular heart.

The causes usually assigned for the development of fishes with a binocular side are all more or less unsatisfactory. It is known that in experiments thereon similar conditions constantly fail to produce similar results. Of the causes assigned the chief are: that the great width of the body in flounders makes the resting on the one side the most natural position; but there are many fishes of far greater width which swim vertically. The absence of a swimming bladder has also been assigned as a good reason, but some flounders have a swim bladder. Alexander Agassiz hints that the true cause may perhaps be that some broad fish may find it much easier to pursue their prey while swimming close to the bottom. They are protected from detection by their coloured side resembling sand, mud, and gravel. This would gradually lead to the exclusive use of one side (should the fish lie on either side) and would result in the atrophy of the eye, unless the fish were able to transfer his eye to the other side and so retain it. But then it will be asked, why do we not find flat fish among the broad forms of every family of fishes? and, remembering that flounders are only found in the most recent geological deposits, why were they not as common in earlier times as at the present day? and, above all, why was the tendency of the eye to change transmitted from generation to generation and not the binocular state itself?

May not, suggests Agassiz, Giards' idea come to our help here. Giards hints that the fundamental cause of all asymmetry in the animal kingdom is due to a difference in the strength of the organs of sense, and he gives in support of this idea some most ingeniously explained

cases. At any rate, the action of light upon the sense organs, which in all embryos are developed out of all proportion to their ultimate conditions, must remain an all-important element in its effect upon the nervous system. In embryos so transparent as those of many young fishes are, which might be said to be nothing but eyes, brain, and notochord, the action of light must be infinitely more potent upon their nervous system than it can possibly be in older stages, when the muscular system has assumed the control.

The pigment cells appear early in the egg. In some fishes, immediately before the little fish is hatched, two colour elements are to be found, black and yellow; but in the majority of cases the black alone is present, the yellow element appearing subsequently, and, last of all, the red. Pouchet's experiments seem to show that the blue pigments are only a dimorphic condition of the red pigments. This, by the way, would account for why a lobster turns red when cooked. The proper mixture of the three colours—black, red, yellow—enables the flounders to imitate most admirably the general effect of their feeding-grounds; so much so that often it requires a most practised eye to detect them. The rapidity with which they can change their colour is also quite striking. Agassiz frequently removed a jar containing a young flounder, which he figures, from a surface imitating a sandy bottom to one of a dark chocolate colour, and in less than ten minutes the black pigments would obtain a preponderance.

The question of the form and development of the pigment cells is also discussed in the memoir. As to the causes of colour in the animal kingdom we would seem to be only on the threshold of an interesting and novel field of inquiry, and it would seem, says Agassiz, very hazardous to infer from a physiological point of view, as has been frequently done on philological grounds, that Homer's colour descriptions indicate a gradual development of the sense of colour in the early races of mankind.

E. Perceval Wright

Since writing the above we have received from Prof. Japetus Steenstrup "Fortsatte Bidrag til en rigtig Opfattelse af Oiestillingen hos Flyndrene," with four plates. This supplemental memoir is in Swedish, and gives a *résumé* of what has been written on the subject since the paper in which the illustrious author first called attention to it, with criticisms thereon. An advance sheet of Agassiz's paper also enabled him to quote the chief details of his observations. The memoir also contains a description with beautiful figures of a Plagusia form, which was captured while its eye was just about to traverse the head obliquely and to take its place on the other side as the upper eye. It also gives a series of figures which make clear the connection that exists between certain frequently met with monstrous forms of flat-fish and the normal forms. One of these thus illustrated is the "malformed brill" figured in Yarrel's "British Fishes."

THE BROWN INSTITUTION

It is now just seven years since the Brown Institution was opened, under the auspices of the Senate of the University of London, as a place for the study of the diseases of animals. It was at that time placed by the Senate under the direction of a committee comprising the most eminent members of the medical profession, with Dr. Sharpey as their chairman. Dr. Burdon-Sanderson was appointed superintendent, with Dr. Klein—who had then recently migrated from Vienna to London—as his coadjutor. A hospital had been built for the reception of diseased animals, and placed under the care of a highly qualified veterinarian, Mr. Duguid, and in connection with it a good and sufficient laboratory had been erected for the purpose of carrying out pathological and therapeutical experiments. No provision could be made from the funds of the Institution for the expenses of such investigations, it having been found necessary to devote the whole available income to the purely charitable purposes which the founder had associated with the investigation of disease in his testamentary statement of the objects he had in view. Pecuniary aid for research was, however, not wanting. The work done in the laboratory was, during the first three or four years, for the most part conducted at the instance of Mr. Simon, who was at that time at the head of the Medical Department of the Privy Council, and it was thus provided for by annual grants of public money. For a time all went on favourably, and it seemed possible that the Brown Institution would eventually fulfil the functions and acquire the importance of those State-supported establishments for research which have recently accomplished so much for the advancement of medical science in Germany. But, alas! clouds soon began to gather. That strange, popular agitation which culminated in the passing of the "Vivisection Act" showed itself to be specially hostile to those systematic experimental investigations which, at the present moment, are absolutely necessary for the elucidation of fundamental questions in pathology. Accordingly, the Brown Institution became a prominent object of attack. When the Act was passed it became apparent that the realisation of the hopes which had been entertained was no longer probable, for it was soon found that, in their bearing on pathological inquiries, the restrictions imposed really amounted to prohibitions.

These circumstances affected the working of the institution in such a way as seriously to diminish its prospect of usefulness. Early in the present year Dr. Burdon-Sanderson, baffled in his plans, resigned his appointment. His resignation has been followed by that of Mr. Duguid, who has accepted a more lucrative position under Government; and finally Dr. Klein, who became a candidate for the vacant superintendentship, and was supported by the unanimous recommendation of the Committee, but was rejected by the Senate of the University, who thus showed that the possession of an academical title confers none of the academical spirit. At the present moment, therefore, the Brown Institution is represented only by the buildings and the endowment. The men who have done its work, and whose names have been hitherto identified with it, have retired. The prospect is discouraging, but not quite so bad as it seems.

The services of Dr. Klein being no longer at their disposal, the Committee proceeded at once to invite other candidates to come forward, and on their recommendation a distinguished graduate of the University, and an energetic and able pathologist, has just been appointed to the vacant office. From Dr. Greenfield's antecedents we feel sure that he will (failing Dr. Klein) prove to be as good a man for the post as could possibly have been selected. Nor will he experience any difficulty in finding sufficient scope for his energies. Whatever obstacles may have been placed by ill-advised legislation in the way of some important lines of scientific inquiry, there are others which remain accessible. One of these lines was opened by Dr. Burdon-Sanderson three years ago. In the beginning of 1876 a grant of 500*l.* was made by the Royal Agricultural Society for the carrying out of scientific investigations at the Brown Institution, as to the nature and origin of some of the destructive contagious diseases of animals which prevail in this country. The results of these inquiries have already been, in part, printed, and others are in course of publication. In consequence of the resignation of Dr. Sanderson and of his veterinary coadjutor Mr. Duguid, the progress of his work has been temporarily arrested. But it is gratifying to be able to state that at the Annual Meeting of the Royal Agricultural Society which took place on